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PROGRESS REPORT NO. 22

TRAVELING-WAVE TUBES

Index No 1116-13, Task 9
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March 1954

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DEPARTMENT OF THE NAVY, BUREAU OF SHIPS
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PROGRESS REPORT NO. 22

TRAVELING-WAVE TUBES

Driver Tube

During the past interval Tubes Nos. 115 and 116 were constructed and tested. Tube No. 116 was a modification of Tube No. 114. It was stated in the last report that Tube No. 114 operated with a power output between 500 and 800 watts. During testing it was believed that beam current to the collector was low, but it was not possible to measure this quantity. In order to make this measurement, an isolated collector was added to the tube, and it was repumped as Tube No. 116. Tests on Tube No. 116 confirmed the belief that the beam transmission was low. The beam conversion efficiency was estimated to be 20 per cent.

In Tube No. 115 several major changes were incorporated. The T. P. I. of the helix was adjusted for 6500-volt operation, and a new type of electron gun was used. This is a Pierce-type converging-beam gun with a perveance of 1.75×10^{-6}. R-f testing was done while continuously pumping the tube. Peak output powers from 1200 to 1800 watts and electronic gain of 25 db were observed. While testing the tube, the water-cooled solenoid developed a shorted turn, and further testing was not possible. The tube was sealed off the vacuum system and is being held for further tests pending the receipt of a new solenoid. The improved performance indicates that the new electron gun and the beam produced by it improve the over-all performance and efficiency. The next series of driver tubes will incorporate this gun and helix.

Output Tube

Experimental Tubes Nos. 8 through 11 have been constructed and tested. These tubes incorporated various types of experimental slotted slow-wave structures. Figure 1 is a plot of two typical voltage and frequency curves for two of the

experimental structures employed. As can be noted, the voltage range for these structures is low. This is due, in part, to a high degree of dielectric loading produced by the helix supports. However, these data, in conjunction with a study of the dielectric loading effects, will enable a structure to be designed which will have the proper voltage and dispersion characteristics for operation with either the low- or high-perveance electron gun. The Pierce-type electron gun was completed and tested. The performance of this gun was according to the characteristics expected. Peak current up to 50 amperes at 40,000 volts operation was measured. With 1 kilowatt of average power in the beam, the grid vanes showed color, although serious heating effects were not observed. A second type of Pierce gun design is being constructed. This new design does not require a gridded anode structure, and it is anticipated that higher average powers can be obtained.

Program for the Next Interval

During the next interval several driver tubes will be constructed employing the new high-voltage electron gun. In addition, these tubes will employ further improvements in helix support and also in center loss design. The output tube slow-wave structure studies will continue, and emphasis will be placed on determining methods of supporting the structures. Quantitative data will be obtained on the effect of support structures on dielectric loading of the slow-wave structure. The new type of Pierce electron gun will be completed, and testing should begin.

Illustration

Fig. No.	Title
1	Voltage-Frequency Characteristics for Slotted Slow-Wave Structures No. 1 and No. 2

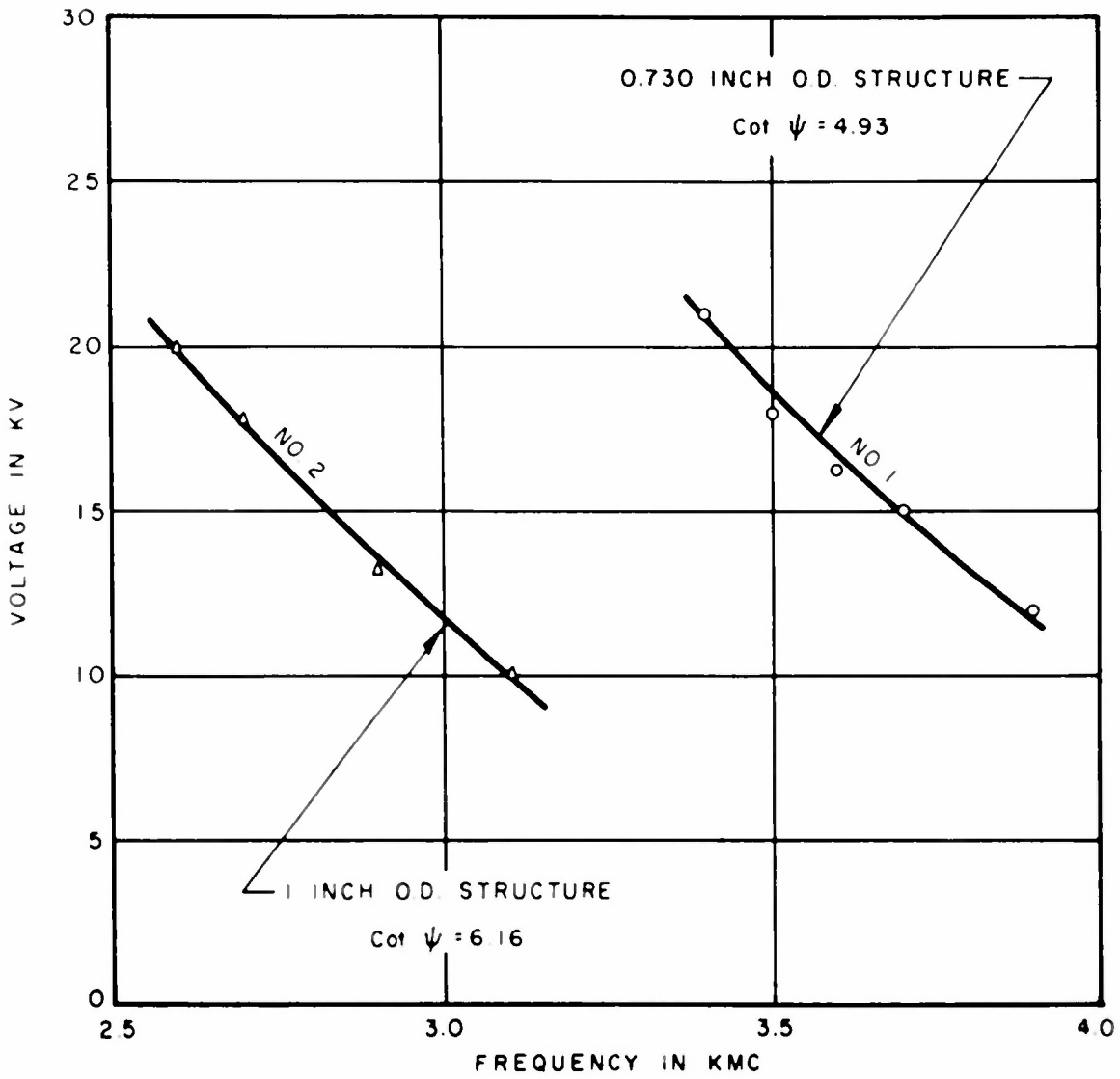

FIG. 1 VOLTAGE-FREQUENCY CHARACTERISTICS FOR SLOTTED SLOW-WAVE STRUCTURES NO. 1 AND NO. 2

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